

Climate change beliefs and savings behavior: a macroeconomic perspective

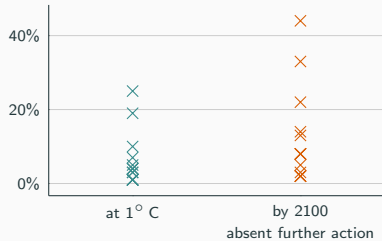
Hannah Römer

November 7, 2025

University of Oxford

Climate change matters: for economy

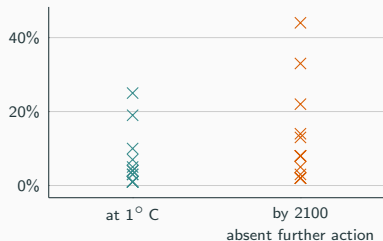
Estimated impacts of climate change
as percentage of GDP



collected by Aerts et al (2024)
calculations based on leading damage functions

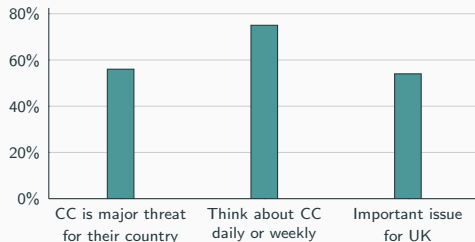
Climate change matters: for economy and population

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Public opinions on climate change



Shares of respondents.
Data from Pew Research (2022, 19 countries),
Peoples Climate Vote (2024, 50 countries),
ONS (2025, UK)

Motivation: beliefs over climate change impacts

Climate change is a major challenge of our time.

But: Highly uncertain → subjective, diverse beliefs

Limited scope for individual actions against climate change: savings?

- + Self-insurance
- Decreasing returns, stranded assets

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What are the macroeconomic implications of climate change beliefs?

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What are the macroeconomic implications of climate change beliefs?

- Do beliefs over climate change affect individual savings?
- Does the effect on capital accumulation have macroeconomic consequences? Today, in the future?
- Does disagreement over climate impacts matter?

Do climate beliefs affect individual savings?

Do climate beliefs matter for macroeconomic outcomes via capital accumulation?

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- Theoretical predictions from analytical model
- Empirical UK survey evidence: observational (representative panel), causal (online questionnaire)

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Do climate beliefs matter for macroeconomic outcomes via capital accumulation?

- **Non-stationary** general equilibrium model with incomplete markets and aggregate risk
 - Climate change as shift in stochastic productivity process
 - Uncertainty over trend in productivity
 - Heterogeneity in income, wealth and beliefs

Key take-aways: climate change beliefs matter.

Climate beliefs increase individual savings both in theory and empirically...

...and affect macroeconomic outcomes during the climate transition.

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- Significant positive relationship between climate change beliefs and savings choices:
Likelihood to save +9pp, savings share +1pp, MPS +7.6%
- Consistent with theoretical predictions when income effects dominate

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- **Climate concern effect:** capital \uparrow output loss from climate change \downarrow
NPV of output: -12% under optimistic versus accurate beliefs
- Higher capital benefits the poor disproportionately: wealth inequality \downarrow
Gini: -0.2% during transition relative to initial value
- Small but persistent impacts of disagreement:
NPV of output: -1.5% under dispersed relative to homogenous beliefs

Climate change impacts on the macroeconomy

- Stochastic damages: Golosov et al. (2014), Cai and Lontzek (2019)
- Anticipation: Bilal and Rossi-Hansberg (2023), Bakkensen and Barrage (2022)

Contribution: Amplified consequences of climate uncertainty in decentralized framework

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Beliefs and disagreement over aggregate (climate) process

- Hong et al. (2023), Bakkensen et al. (2023), Chen et al. (2012), Lontzek et al. (2024)

Contribution: Implications along the transition

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Contribution: Implications along the transition

Incomplete markets and aggregate risks: theory and computation

- Krusell and Smith (1998), Farhi et al. (2022), Broer et al. (2022), Fernández-Villaverde et al. (2023), Bilal (2023), Auclert et al. (2021), Moll (2024)

Contribution: Non-stationarity in aggregate process, global solution method

Predictions in partial equilibrium

Consumers allocate resources intertemporally to maximize **expected** life-time utility, subject to budget constraint and borrowing limit.

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Two types of uncertainty affect income:

- Aggregate state: **dependent** on climate change
 - Productivity: pins down average wages and asset returns
 - Two possible states: low and high
- Idiosyncratic state: **independent** of climate change
 - Demographics: affects labor income

Model details

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Model details

How do savings depend on beliefs over climate change?

- How do intertemporal choices respond to changes in **probabilities** of aggregate states?
- First order response to perturbation in probability from Euler equation (cf. Farhi et al., 2022)

First order consumption response

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Take-aways:

1. Concern over adverse macro risks: individual savings \uparrow in standard model
2. Opposing forces of current idiosyncratic state: large effect for **poor savers**

Empirical evidence

Model predictions:

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Two types of UK survey evidence:

1. Observational: large, representative UK panel survey
2. Causal: specific purpose online questionnaire

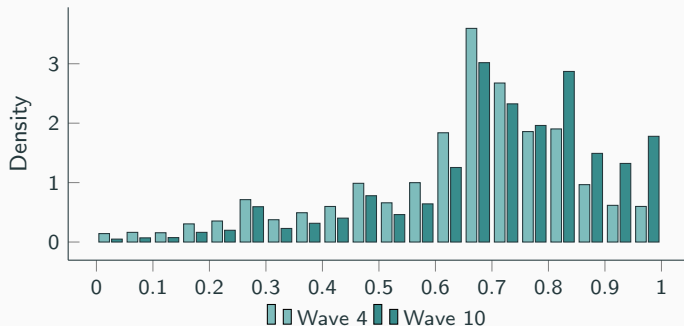
UK Longitudinal Household Survey, waves 4 and 10 (2012-13, 2018-19)

- Construct index about **climate change concern**

Climate concern index

Five questions on beliefs over climate change, e.g.

- People in the UK will be affected by climate change in the next 30 years.
- If things continue on their current course, we will soon experience a major environmental disaster.



mean = 0.72

standard deviation = 0.22

autocorrelation = 0.53

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 - education, income, age, children, residence, flood exposure (matched)

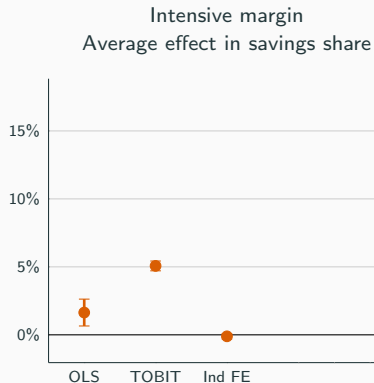
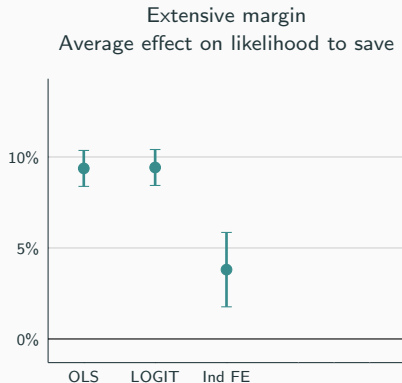
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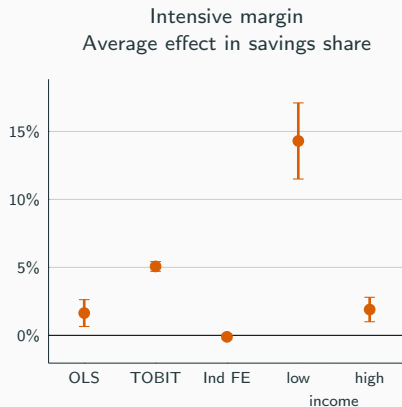
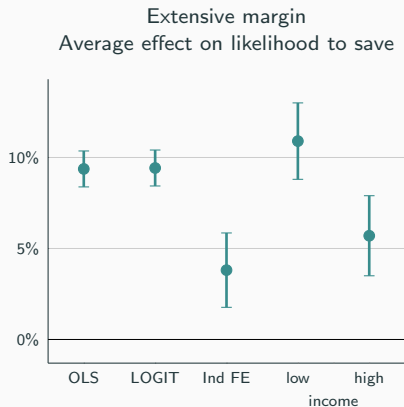
Addresses two main concerns:

1. Preferences over risk and time → Individual fixed effects
2. Idiosyncratic exposure → Flood exposure, area fixed effects

Empirical results: full versus no concern



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Specific purpose online survey

Goal: obtain causal evidence by using within-subject design (cf. Andre et al., 2025)

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Full sample	
Δs	7.6%***
Observations	543

Income		
low	medium	high
10.0%***	7.2%**	5.3%
178	230	81

Survey design

Sample

Questionnaire

Key take-aways:

- Passthrough of adverse aggregate risks: savings \uparrow depending on idiosyncratic state
- Empirical evidence: positive relationship between climate concern and savings choices

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Open question: Do climate change beliefs matter for the macroeconomy?

- How does additional capital accumulation affect output losses during **climate transition**?
- Does the **observed disagreement** over climate change matter for **macroeconomic outcomes**?

→ Dynamic general equilibrium model

Dynamic general equilibrium model

General equilibrium model: endogenous prices

Households

- are subject to idiosyncratic shocks: income and life-cycle;
- consume and save to maximize EU, given budget constraint and borrowing limit.

Representative firm

- produces using capital and labor;
- pays wages and interest;
- is subject to productivity shocks $\zeta_t \in \{\zeta^L, \zeta^H\}$, $\zeta^L < \zeta^H$.

Market clearing

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Climate change

- causes exogenous and deterministic increase in global temperature T_t ;
- which is known at time $t = 0$ and may affect the frequency of low productivity states.

→ Non-stationarity

Probability of adverse aggregate shock is given by $\mathbb{P}(\zeta_t = \zeta^L) = p^{1-\gamma T_t}$ with **unknown** parameter γ

- Two possible states of the world: $\gamma \in \{0, \bar{\gamma}\}$
- Individual initial belief $\pi_{i0} = \mathbb{P}_{i0}(\gamma = \bar{\gamma})$
- Bayesian updating

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Impacts modeled via **probability**, levels stay constant

- **Any** draw $\{\zeta_t\}_t$ possible under **all** beliefs
- Implicit level effect

Aggregate capital is both **endogenous outcome** and **input for decision** of forward looking consumer.

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Assumption: bounded rationality

Decisions are based on Perceived Law of Motion (PLM)

$$K' = \mathcal{H}(K; \mathcal{X}) \quad \text{for some explanatory variables } \mathcal{X}.$$

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How to choose PLM?

1. Find self-justified equilibrium to approximate rational expectations (Krusell and Smith, 1998)
→ extend idea to non-stationary framework
2. Alternative: adaptive expectations with varying degree of memory dependence
→ addresses critique by Moll (2024)

For period t : Ψ_t **distribution of agents** over demographics, asset holdings and beliefs.

Dynamic equilibrium

For a given draw $\{\zeta_t\}_t$, initial distribution Ψ_0 and PLM \mathcal{H} , the *dynamic equilibrium* of the economy is given by a sequence of distributions $\{\Psi_t\}_{t \geq 0}$ so that:

1. Each period, households and firms optimize given their beliefs; markets clear.
2. Ψ_t evolves according to (i) demographic dynamics, (ii) savings choices, and (iii) Bayes' formula.

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Summary statistics

- Stochastic steady state
- Ensemble averages

Fix some functional form

- Obvious candidates for \mathcal{X} : shock ζ , temperature T , personal belief π
- Guess for \mathcal{H}
 - linear in $\pi \rightarrow$ estimate only for $\pi \in \{0, 1\}$

Solution algorithm: PLM estimation

Fix some functional form

- Obvious candidates for \mathcal{X} : shock ζ , temperature T , personal belief π
- Guess for \mathcal{H}
 - linear in $\pi \rightarrow$ estimate only for $\pi \in \{0, 1\}$

Generate simulated data

- Non-stationarity: **ensemble** of shock sequences
 - Stratified sample: Match theoretical mean and variance within each period

Iterate on parameters until convergence.

Stratification procedure

Model selection

Adaptive expectations with memory

Model performance

Heterogeneity in forecasts

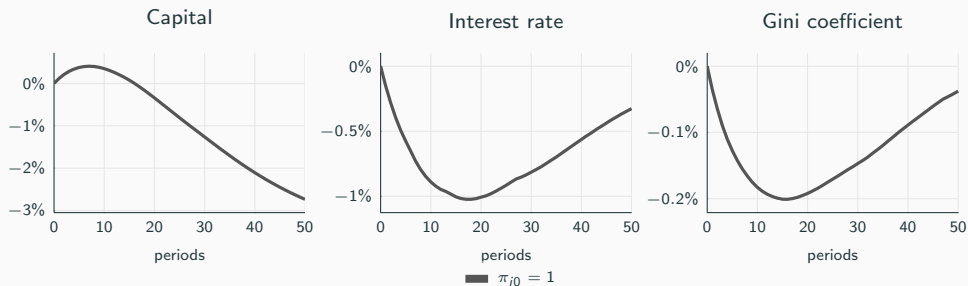
Calibration

Macroeconomic effects of climate beliefs

The climate transition

Baseline: $\bar{\gamma} = \gamma$

How does the climate transition affect the macroeconomy if **everyone expects** productivity impacts?

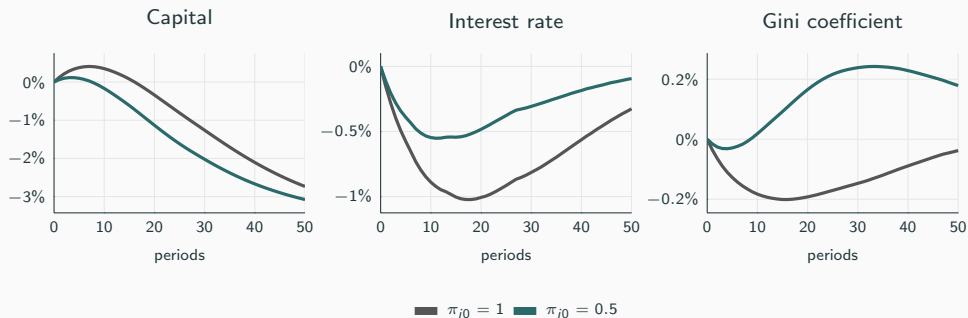


Ensemble averages over time, relative to initial SSS

The role of beliefs during the climate transition

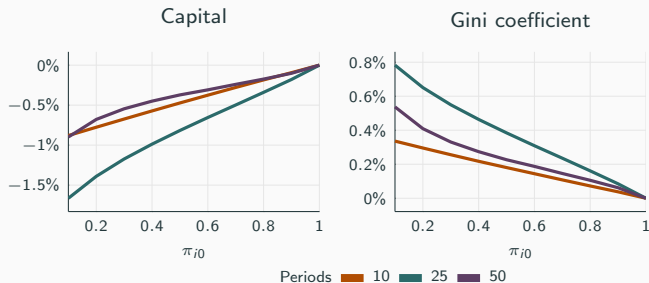
Capital ↓ if population assumes 50% chance of no productivity impacts

→ wealth inequality rises



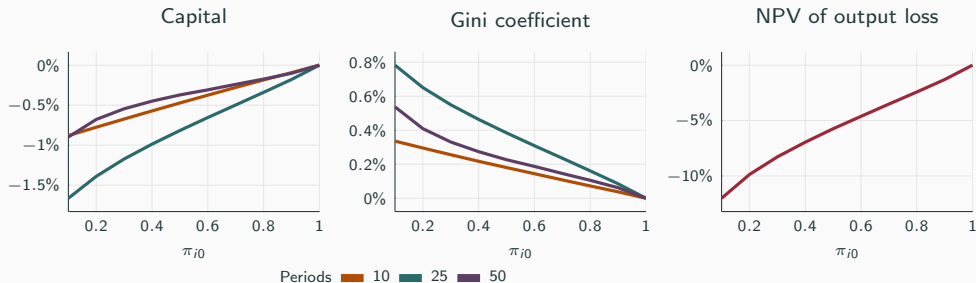
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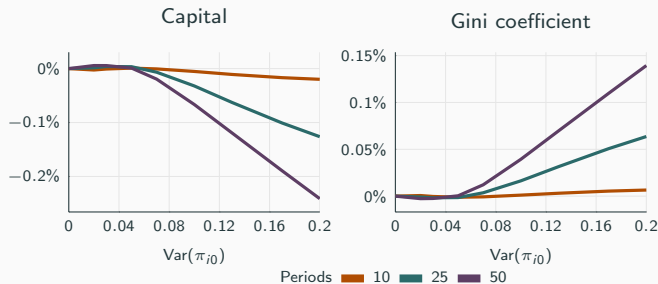
Relative deviation to $\pi_{i0} = 1$, no belief heterogeneity

The role of beliefs during the climate transition



Relative deviation to $\pi_{i0} = 1$, no belief heterogeneity

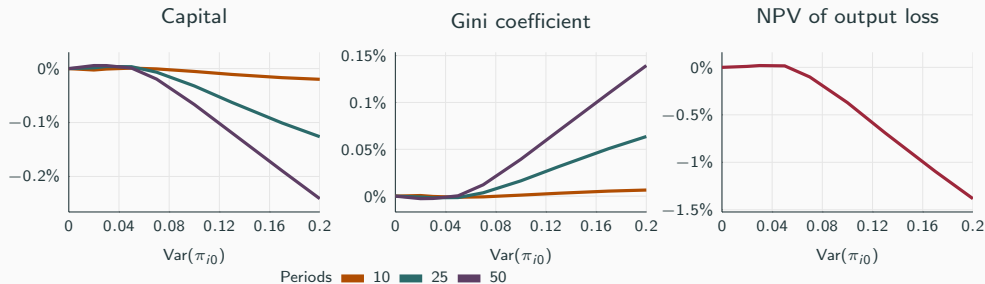
The effects of belief dispersion



Relative deviation to $\text{Var}(\pi_{i0}) = 0$ at $\mathbb{E}(\pi_{i0}) = 0.7$.

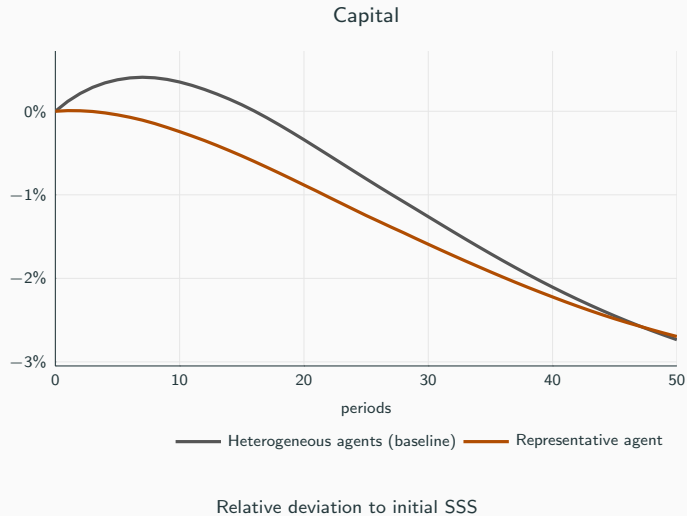
- Capital \downarrow Gini \uparrow under mean-preserving spread
- Persistent: deviation rises even after 25 years
- Small effects compared to variation in first moment

The effects of belief dispersion



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- Small effects compared to variation in first moment

Mechanisms: the role of incomplete markets



Additional results

- Climate change deniers $\pi_{i0} = 0 \rightarrow$ endogenous polarization
- Alternative true model $\gamma \rightarrow$ asymmetric effects
- Welfare analysis \rightarrow gains for future generations

Robustness

- Alternative PLM: memory matters

Individual behavior

- Climate concern increases individual savings in model of aggregate climate damages
- Consistent with UK survey evidence

Aggregate and distributional effects

- Climate concern effect: capital increases in short-run, attenuates climate damages
- Heterogeneous impacts: wealth inequality ↓
- Disagreement: small but persistent role

Beliefs over aggregate risks in incomplete markets

- Development and solution of non-stationary model
- Applicable to range of questions on uncertainty and disagreement over structural shifts

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Earnings and life-cycle:

- AR(1) process for skills estimated on UK panel data
- Expected duration working life (retirement): 40 (20) years; replacement rate 60%

Aggregate shocks: Effect of climate change on UK productivity

- AR(1) process for temperature, long-run increase of 0.9 deg within 75 years.
- Meta study Rising et al. (2022) estimates output losses:

1.1% in 2022, 3.3% by 2050, 7.4% by 2100

- Bad states $p_0 = 0.15$, $\zeta^L = 0.93$:

$$\mathbb{E}(\zeta_0) = 0.9895, \mathbb{E}(\zeta_{100}) = 0.965$$